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ABSTRACT

The presence of chlorinated solvent source zones in the subsurface pose a continuous threat to groundwater quality. The remediation of Dense Non-Aqueous Phase Liquid (DNAPL) sites is especially challenging and the development of innovative remediation technologies is needed. Zero-valent iron (ZVI) technologies have proven effective for remediation of chlorinated compounds. ZVI-Clay soil-mixing is a new remediation technology, which combines abiotic degradation (via ZVI addition) and immobilization (via soil-mixing and clay addition), whereby a great potential for reduction of both contaminant mass and mass discharge is obtained.

The technology was tested at a Danish DNAPL site, where the secondary aquifer was heavily contaminated by tetrachloroethene (PCE). ZVI-Clay soil-mixing was tested at a small source zone (~200 m^3) with soil concentrations ranging up to 12,000 mg/kg. The objective of the field test was to document *in situ* destruction of the contaminant mass and the down-gradient response in contaminant mass discharge.

The field sampling consisted of baseline measurements and a 19-month monitoring program (7 sampling campaigns) subsequent to the implementation of ZVI-Clay soil mixing. The concentrations of chlorinated ethenes were monitored via soil sampling at the source zone and groundwater sampling at a control plane with multilevel samplers covering the entire contaminated plume down-gradient (3 m) of the source zone.

The results showed a significant mass depletion of PCE (2-3 orders in magnitude) with ethene as the main degradation product. The down-gradient reduction of contaminant mass discharge occurred more slowly; after 19 months a mass discharge reduction of 76 % was obtained for PCE. However, due to a temporary increase in cis-DCE, the overall down-gradient reduction of all the chlorinated ethenes was limited to 21 %. Long-term modeling (Comsol Multiphysics) was used to predict that a contaminant mass discharge reduction of 2-3 orders in magnitude will take 3-5 years.

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